Sika Solutions
for the Refurbishment of Concrete Bridges

Innovation & Consistency | since 1910

Concrete Bridges – Important and Valuable Infrastructure

Throughout history, bridges have always been important and valuable structures in their own right and as part of our infrastructure, allowing faster and easier communication and transportation for people, livestock and merchandise. This means that by their very nature, bridges are built in areas where the topography, the ground conditions, or other existing structures and developments mean that these locations are not suitable for conventional pathways, roads or railway construction.

Therefore bridges are found in a wide variety of the most challenging and exposed environments – crossing ravines, around mountains, over valleys, lakes, rivers and even seas or other urban buildings and structures. Due to the seemingly continuous increase in traffic frequency and design load across our bridge structures, additional stress and strain are also constantly being imposed on them.

Modern bridges are built predominantly in reinforced concrete and are these are generally designed with a service life expectancy of more than 100 years. Recent surveys in both Europe and North America have shown that the majority of our existing bridges already exhibit some significant degree of degradation and many of them are therefore in need of substantial and often urgent, repair and refurbishment works.

Content

Refurbishment of Concrete Bridges with Sika – Long Lasting, Cost Effective and Sustainable

Durability

Reinforced concrete bridges are designed to maintain their service and function over long periods of time. During this service life, the concrete is subjected to many aggressive influences, including variable loading and vibration, extreme weather conditions, the presence of chlorides in de-icing salts and cycles of freeze and thaw, plus air borne chlorides in marine environments.
For new bridges, Engineers need to produce concrete that is able to achieve this long service life. All relevant Codes of Practice and Standards must be closely followed, including adequate concrete cover over the steel reinforcement, good compaction and no voids etc. Many of our existing concrete bridges are not built according to these latest standards, which is one reason for the damage and deterioration that results in a significant reduction of their life expectancy.
To reduce maintenance costs, materials should only be applied that have proven durability, can increase the service life and reduce the frequency of such maintenance. Sika provides an extensive range of solutions for the repair, protection and strengthening of concrete and also steel bridge structures, to ensure that they can meet their required durability.

Life Cycle Management

Appropriate life cycle costing and management in all areas of bridge design, construction and management, including the correct maintenance, not only safeguards the owners investment, but also ensures the safety of the bridge users, maintains the level of its capabilities and community functions; plus frequently these landmark structures can also become an important part of a city, region or even a national heritage.
Life cycle costing and management provides bridge owners with the best approach to minimising any closure times and increasing the periods required between scheduled maintenance works, thereby also achieving the lowest total cost over the full service life of the structure.
Sika provides bridge owners and their maintenance managers the right design and planning tools, followed by well designed and proven, complete refurbishment solutions and systems, to considerably increase the time between the necessary maintenance and / or repair cycles. This is of considerable help in saving not only in the overall defined life cycle costs, but also in saving the bridge owners and the bridge user's time, the personal costs of delays and closures, plus the environmental impact of their bridges.

Sustainability

In addition to durability, sustainability and responsibility for the environment have become an increasingly important component of the requirements for the refurbishment of bridge structures. Indeed the environmental impact of any such public works is also an increasingly important part of every projects pre-contract 'risk assessment' under the latest regulations.
The responsible use of our limited natural resources is essential for future generations, therefore the whole bridge refurbishment process also has to be considered in relation to the selection of refurbishment materials that sustainable and ecologically harmless so far as is possible.
This also includes the potential to minimise pollution increasing traffic delays, power consumption in the materials production, safe waste and packaging disposal and minimising the use of scarce resources.
Sika is striving for a more sustainable environment by optimizing our logistics, reducing energy consumption, reducing natural resources in our production processes and by developing innovative, solvent free refurbishment solutions to limit the release of VOC's (volatile organic compounds) for example. In addition Sika actively supports many varied green projects on a global, regional and local basis worldwide, to create a more sustainable future.

Sika – 100 years of Experience

Sika has experience in the refurbishment of all types of reinforced concrete structures. With well known, well proven and innovative systems in our complete product range, Sika can provide bridge maintenance contractors and their customers with the appropriate solution for all types of bridge refurbishment and maintenance works. These include: concrete repair and protection, structural deck waterproofing, structural strengthening, steel corrosion protection, watertight joint sealing, high performance grouting and structural bonding solutions (rigid and elastic). Sika's depth of expertise comes from a world wide experience in bridge maintenance and refurbishment, gained during more than 100 years in the complex business of construction chemicals.
Sika produces consistent quality controlled products and systems, with solutions for bridge refurbishment, all supplied to site through efficient logistics. Overall it is our well trained Sika specialists that are the key factors for our success in providing durable, cost efficient and effective bridge refurbishment solutions.
Numerous successful projects around the world reflect the satisfaction of our many customers: Bridge Owners and Operators, Consulting Engineers and other Specifiers, Main Contractors, Specialist Contractors and Material Distributors are all benefitting from the unique "Added-Values" from Sika.

The Exposure of Concrete Bridges

Water Ingress
Water can penetrate naturally through the capillary pore structures of reinforced concrete. In areas of carbonated concrete, or where there is a high chloride content on the surface of the steel reinforcing bars, reinforcement corrosion, cracks or spalling can occur on the surface.

Dynamic and Static Load
Overloading due to increasing traffic loads, inadequate design, damage to the structure, stress / fatigue failure, earthquake effects, or any other mechanical impact such as vehicle impact, can all exceed or reduce the load capacity of the structure

Wide Temperature Variation
By their nature and locations, bridges are subjected to a wide variation of temperatures between day and night / winter and summer conditions, or between different sides or surfaces of the structure. These frequent cycles result in thermal stresses and movement in the concrete structure that can also result in cracks.

Carbon Dioxide
Carbon Dioxide (CO_2) reacts with the Calcium Hydroxide ($Ca(OH)_2$) in the pore liquid of the cement matrix of concrete structures and deposits as calcium carbonate ($CaCO_3$). This process known as carbonation reduces the protection of embedded steel reinforcement, when the process reaches the reinforcement bars.

Chlorides Ingress
Chlorides come from de-icing salts used in winter, or from salt water in marine environments. They can penetrate the concrete structure and once they reach the reinforcement bars, they can locally destroy the passivation film causing fast pitting corrosion.

Freeze / Thaw Action
The freeze thaw process creates stresses in the concrete matrix due to the expansion of free water in the capillary pores during freezing conditions; this can result in scaling of the surface of poor quality concrete. This action is also greatly accelerated by the presence of chlorides in the water.

Surface Erosion / Abrasion
Concrete elements submerged in water such as the bridge piers or columns, are continuously exposed to erosion and abrasion of their surfaces. Damage occurs from the action of fast flowing water, and the particles of sand or other solid materials in the water.

Fire Damage
Fire due to traffic accidents, for example, can result in a reduction of the structural integrity of any of the concrete elements including the columns, decks or precast segments etc.

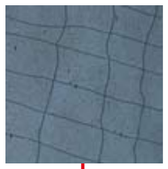
Concrete Damage and Deterioration – The Root Causes

Steel Reinforcement Corrosion

Root Cause: (Examples)
- Chloride ingress
- Carbonated concrete
- Stray electrical current

Leaching/Efflorescence

Root Cause: (Examples)
- Water ingress

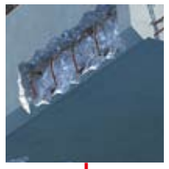


Non-Structural Cracks

Root Cause: (Examples)
- Shrinkage
- Thermal movement
- Alkali Aggregate Reaction (AAR)

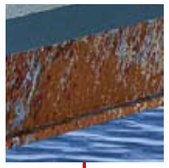
Structural Cracks

Root Cause: (Examples)
- Overloading
- Structural movement/Vibration
- Earthquake impact



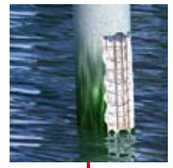
Concrete Spalling

Root Cause: (Examples)
- Steel reinforcement corrosion
- Freeze/Thaw action
- Impact



Steel Corrosion

Root Cause: (Examples)
- Inadequate steel coatings
- Chloride ingress
- Water ingress



Scaling of Concrete Surface

Root Cause: (Examples)
- Erosion
- Abrasion
- Salt expansion
- Freeze/Thaw action

General Bridge Refurbishment Considerations

Before defining the repair and protection strategy including detailed refurbishment procedure, the specific bridge project related refurbishment requirements must be considered. These requirements can have an important influence in determining the correct design, planning and construction procedures, together with the future maintenance works necessary for the bridge. Examples of these project related requirements are outlined below.

Durability

Remedial works on a bridge structure can have a significant cost; hence the frequency of these works should be as far apart as possible. Therefore the products used in bridge remedial works must provide adequate durability to extend the frequency to the defined service life.

Total Life Cycle Costing

The total costs must take into account the actual costs of the remedial works plus the maintenance costs of the defined service life. This significantly influences the selection of the appropriate refurbishment concept and the specific materials to be used.

Duration of Closure

The time for the bridge or lane closure has a direct influence on the cost of remedial works. The choice for the selection of repair and protection systems must allow a fast return to service and therefore reduce the disruption of traffic to a minimum.

Exposures / Site Conditions

The specific site exposure and environmental conditions, such as the climate, access and space for materials application, also significantly influences the selection of the refurbishment concept and/or the appropriate materials and application techniques.

Aesthetic Issues

Concrete bridges are often built with innovative designs and can become well known landmarks in a region. Therefore the aesthetic considerations can often also play an important role in the design and execution of bridge remedial works.

Trafficking

To minimise traffic disruption long periods of remedial works have to be prevented. Repairs also have to be done under live traffic loading. This requires special materials and only systems which are specifically tested to be suitable for application under dynamic load will achieve the required quality and durability.

System Compatibility

Remedial work on complex bridge structures often demands a complete and integrated system buildup. It is very important that all of the products used are compatible. The use of one full range system supplier with proven compatible products and systems ensures that this is achieved.

Ecology

Environmental friendly and sustainable materials such as solvent free products help to safeguard the environment. These are increasingly an important requirement and in some countries, additional taxes now have to be paid for products that release Volatile Organic Compounds (VOC's).

General Bridge Refurbishment Procedures

The repair and protection of reinforced concrete bridges must always be executed according to all relevant local Standards and Regulations. After a detailed condition survey and root cause analysis, the right procedures for successful refurbishment can be defined. Standards (such as European Standard EN 1504-9) define Principles and Methods to be refurbish damaged concrete. Please refer to our Brochure 'The Repair and Protection of Reinforced Concrete with Sika' for more information relating to repair and protection according to EN 1504-9.

Types of Damage / Defects (Examples)		Possible Principles / Methods: For the Repair	Possible Principles / Methods: For the Protection
Concrete Spalling / Scaling of Concrete Surface		■ Concrete Restoration (Method 3.1 / 3.3)	■ Protection against Ingress (Methods 1.1 /1.2 / 1.3) ■ Physical Resistance (Method 5.1 / 5.2 / 5.3)
Steel Reinforcement Corrosion		■ Restoring passivity (Method 7.2)	■ Increasing resistivity (Method 8.1 / 8.2 / 8.3) ■ Cathodic Control (Method 9.1) ■ Cathodic Protection (Method 10.1) ■ Control of anodic areas (Methods 11.1 / 11.2 / 11.3)
Structural Cracks		■ Concrete Restoration (Methods 3.1 / 3.3) ■ Crack Injection (Methods 4.5 / 4.6)	■ Structural Strengthening (Methods 4.1 / 4.3 / 4.4 / 4.7)
Non-Structural Cracks		■ Filling of cracks (Method 1.5)	■ Protection against Ingress (Method 1.1 /1.2 /1.3) ■ Moisture Control (Method 2.1 / 2.2 / 2.3) ■ Physical Resistance (Methods 5.1 / 5.2 / 5.3)
Leaching / Efflorescence		■ Filling of cracks (Method 1.5)	■ Protection against Ingress (Method 1.1 – 1.8) ■ Moisture Control (Methods 2.1 / 2.2 / 2.3)
Structural Steel Corrosion		■ (None)	ISO 12944 Refers to the Corrosion Protection of Steel Structures

Sika – Your Complete System Supplier

Sika is a global market and technology leader in specialist construction chemicals such as bridge refurbishment products. We have manufacturing facilities worldwide and regional subsidiaries in over 70 countries. Our extensive experience and expertise have been gained from the past 100 years of working on the refurbishment of reinforced concrete bridges and other civil engineering structures.

Sika today provides a complete range of innovative products and systems especially designed to solve all of the challenging requirements and situations in the differing specific bridge refurbishment project requirements and site conditions anywhere in the world.

Examples of Sika's Leading Innovations for Bridge Refurbishment Projects

Concrete Admixtures

For durable concrete mix design and placing.

Watertight Joint Systems

For watertight sealing of all types of movement and construction joints.

Liquid Applied Waterproofing Membranes

For durable crack-bridging protection of bridge decks.

Concrete Repair Systems

For secure concrete repair works even under dynamic loading.

Corrosion Inhibitors

Protecting embedded steel reinforcement without changing the concrete appearance.

Post-tensioning Systems

For highly efficient structural strengthening of reinforced concrete bridges.

The "Added Values" from Sika

Sika provides full support to bridge owners, designers and contractors with the necessary technical advice and assistance to ensure a successful project. This includes assistance in every step of the refurbishment process, from the initial condition survey and assessment, the root cause diagnosis, specification writing, detailing, method statements, on site quality control and practical application assistance.

Sika's expertise can make a significant contribution in minimizing the total project cost over the full defined service life-cycle.
Additionally this expertise and our local presence globally, means that our clients and their customers has technical support to solve their specific problems, whether in the design office or on site.

Additional Arguments for Sika are:

Sika's experience – continually developed since 1910.

Sika's expertise and competence – all over the world.

Sika's complete system compatibility – reliably proven and tested.

Sika guarantees – for a reliable partnership.

Sika's innovative solutions and systems – for durable bridge structures.

Sika's full project support – from design to completion, through all project phases.

Sika's complete product range – all solutions from one single-source supplier.

Sika's application engineering – for the most efficient and cost effective application.

Sika's additional testing developments – for totally reliable products and systems.

An Overview of Sika Solutions for Rehabilitation of Concrete Bridges

Concrete Technology

see page 16/17

- High early strength concrete
- Watertight concrete
- Rapid hardening concrete
- High durability concrete
- Ultra high strength concrete

Structural Strengthening

see page 20/21

- Flexural strengthening systems
- Shear strengthening systems
- Axial strengthening systems
- Impact strengthening systems
- Earthquake strengthening solutions

Concrete Repairs

see page 18/19

- Bonding bridge primers
- Reinforcement corrosion protection
- Hand applied concrete repairs
- Machine applied repairs
- Levelling and fairing mortars

Structural Bonding

see page 30/31

- Structural epoxy adhesives
- Structural resin anchoring
- Structural resin injection

Deck Waterproofing

see page 22/23

- Joint sealing solutions
- Watertight structural injection
- Waterproof epoxy overlays
- Liquid applied waterproofing membranes
- Bonding primers for asphalt

Concrete Protection

see page 24/25

- Hydrophobic Impregnations
- Impregnations
- Rigid and flexible coatings
- Corrosion inhibitors
- Galvanic and cathodic protection systems

Grouting and Fixing

see page 26/27

- Structural grouting systems
- Embedding and fixing mortars
- Elastic rail fixing grouts

Steel Protection

see page 28/29

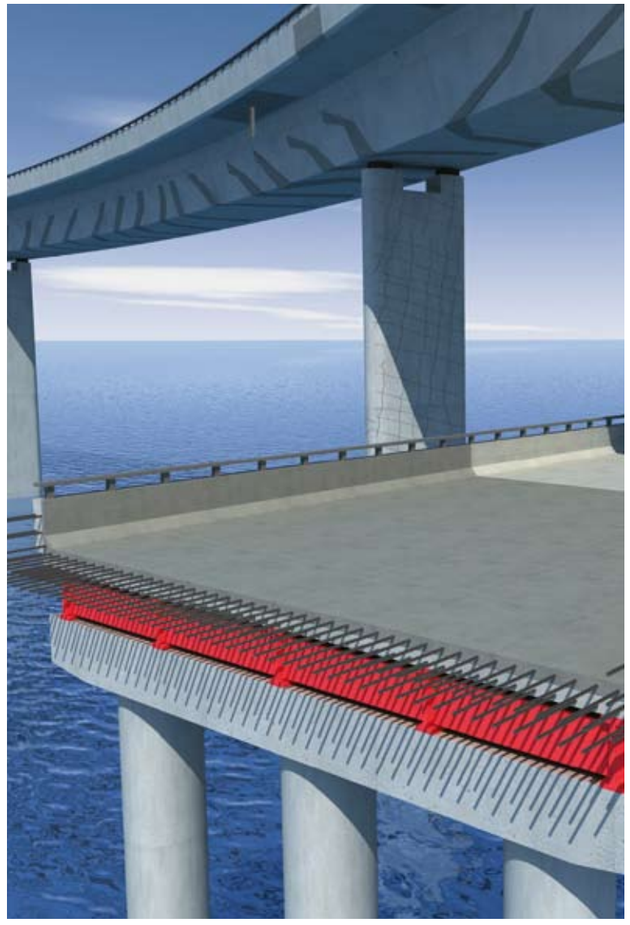
- Steel corrosion protection systems
- Steel maintenance systems
- Steel cable protection systems

Sika Solutions for Concrete Replacement

Overview
In many different situations, such as with extremely high chloride exposure and penetration, or structural deterioration and damage, the concrete is beyond economic repair and has to be replaced. For efficient refurbishment of large scale areas, mostly high quality / high performance concrete must be used for this replacement.

Requirements
- Highly durable concrete with reduced permeability and excellent resistance to the anticipated future exposure
- High early strength development to reduce closure time
- Extended workability and excellent flowability to allow fast, easy and secure concrete placing with assured concrete performance
- Optimized utilization of the available raw materials (including recycled aggregates)

Sika in Concrete Production
The development and production of innovative concrete mix designs using special admixtures has been a core Sika business since 1910. Our technology and high quality products have been continuously developed during this century of experience. Sika provides the most complete range of admixture technologies and products for the efficient replacement of highly durable concrete.

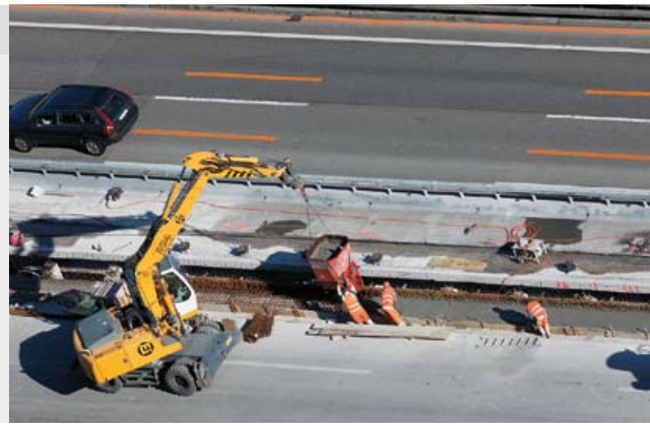


Sika Solutions for Highly Durable Concrete

Increasing the durability of concrete by using:
- **SikaControl®-40** to minimize shrinkage of concrete
- **SikaAer®** to increase the frost and freeze/thaw resistance
- **SikaFume®** silica fume to increase the density of the matrix
- **Sika® FerroGard®** corrosion inhibitor to prevent the corrosion of steel reinforcement
- **Sika® Antisol®** for controlled curing of the concrete for significantly enhanced durability

Sika Solutions for High Early Strength Concrete

High early strength concrete for reduced closure times is achieved by:
- High range water reduction and plasticizing with **Sika® ViscoCrete®** and **SikaPlast®** technology, to provide enhanced strength development and precisely controlled concrete workability
- Hardening or set acceleration to speed up the hydration process using **SikaRapid®** technology



Added Value from Sika in Concrete Replacement

Secure connection and bond of 'new' to 'existing' concrete

With **SikaTop® Armatec®-110 EpoCem®** anti-corrosive bonding primer, durable and high strength adhesion of new concrete to the existing bridge decks is achieved with the correct transmission of structural shear loads.

Advantages:
- High strength bonding of new to existing concrete
- Structural shear load transmission
- Extended open times during concreting operations
- Fast and easy application by spray

Sika Solutions for Self Compacting Concrete

Casting concrete with maximum flowability for specific periods of time without the need for vibration by the addition of:
- **Sika® ViscoCrete®** technology for highly flowable and workable concrete with optimized raw material usage, based on powerful water reduction with extended workability time
- **Sika® Stabilizer®** for improved stability of the Self Compacting Concrete even with inferior quality aggregates
- **SikaFume®** silica fume to provide increased density and durability of the matrix, with enhanced fresh concrete stability

Sika Solutions for Concrete Repairs

Overview
Repairing damaged concrete is one of the primary requirements in the maintenance of concrete bridges. Localized spalling or full surface scaling of concrete surfaces has to be repaired with durable concrete repair materials. A sound and correctly repaired concrete substrate is also the basic requirement for any additional waterproofing, protection or strengthening systems to be applied.

Requirements
- Full system compatibility (bonding bridge, repair mortar, levelling mortar)
- Approved for structural repairs where required (e.g. class R3 or R4 according EN 1504-3)
- Low crack sensitivity
- Fast and easy application

Sika Concrete Repair Expertise
Sika provides an extensive range of thoroughly tested and proven repair materials and systems based on different technologies for each specific requirement and situation. These include bonding and corrosion protection primers, hand and machine applied repair mortars, suitable for vertical and overhead application, semi-fluid mortars for efficient bridge deck repairs, plus combined surface levelling and protection mortars, not requiring additional protective treatments (**EpoCem**®-technology).

Sika Solutions for Horizontal Repair Works

Thin-layer repair system for bridge decks:
- Bonding bridge primer for large area repairs (where relevant):
  SikaTop® Armatec®-110 EpoCem®
- Semi-fluid repair mortars for large area repairs:
  Sika® MonoTop®-432 N
- Thixotropic repair mortars for local patch repairs:
  Sika® MonoTop®-412 series
- Self-levelling, epoxy modified, cement based levelling mortars:
  Sikafloor®-81/-82 EpoCem®

Sika Solutions for Vertical Repair Works

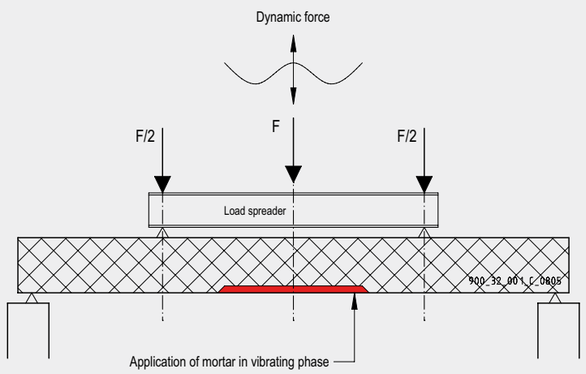
Structural concrete repair system for columns and beams:
- Bonding primer (where relevant):
  Sika® MonoTop®-910 N or **SikaTop®Armatec-110 EpoCem®**
- Hand or wet spray machine applied repair mortars:
  Sika® MonoTop®-412/-352 series
- Surface levelling and fairing mortars:
  Sika® MonoTop®-723 N or **Sikagard®-720 EpoCem®**

Added Value from Sika in Concrete Repairs

Time Saving in Surface Preparation

Sika's tested and unique **Sikafloor EpoCem®** technology for fast bridge deck repairs and short waiting time for application of waterproofing systems

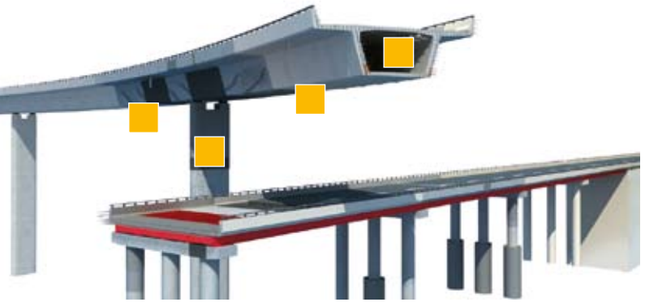
Advantages:
- Reducing the waiting times required before applying bridge deck waterproofing
- For reduced substrate preparation because of better bonding due to epoxy resin



Sika Solutions for Overhead Repair Works

Structural concrete repair systems for soffits and other surfaces under live dynamic loading:
- Bonding bridge primer:
  SikaTop®Armatec®-110 EpoCem®
- Hand or machine applied repair mortar:
  Sika® MonoTop®-412 series
- Surface levelling mortar:
  Sika® MonoTop®-723 N

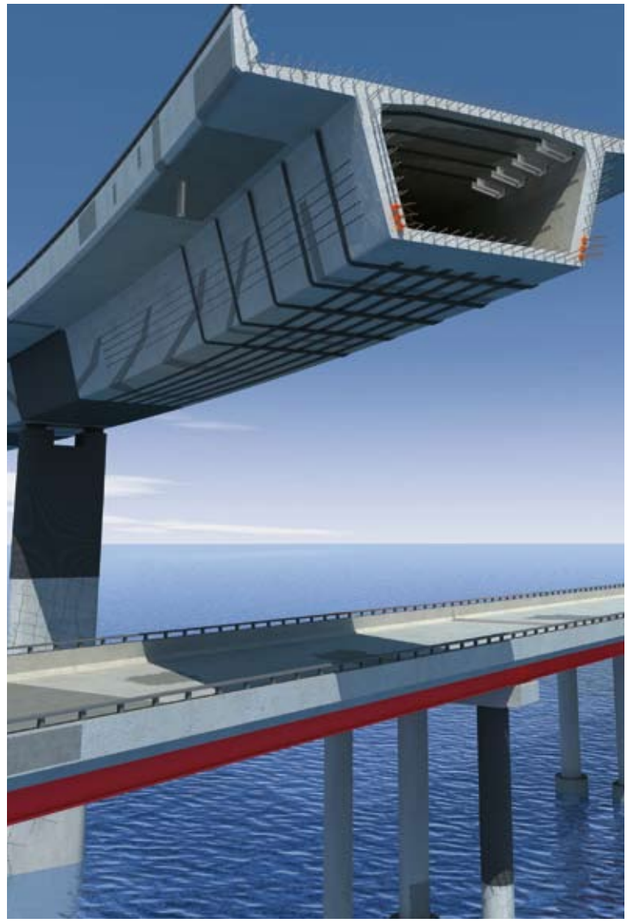
Sika Solutions for Structural Strengthening



Overview
If the existing steel reinforcement is reduced in capacity due to corrosion, if the traffic loads are increased (i.e. permissible axle weights), or if the structural design or seismic resistance needs improvement, then reinforced concrete bridges have to be strengthened.

Requirements
- High tensile resistance or high modulus of elasticity to reinforce and upgrade the structurally deficient beams, slabs, columns, etc.
- Easy to install and corrosion resistant materials for exposed environments.
- Fast application to reduce traffic closure times.

Sika in Structural Strengthening
Sika has been involved in structural strengthening since the development of the technology in the 1960's using bonded steel plates. Since 1991 Sika has also been a pioneer with the development of carbon fibre reinforced polymers based structural strengthening systems. As the clear worldwide leader in the structural strengthening of all types of reinforced concrete structures, Sika provides a full range of fully tested and approved strengthening systems.



Sika Solutions for Flexural Strengthening

Structural strengthening systems for the flexural strengthening of bridge decks, consisting of **Sikadur**® structural epoxy adhesives and:
- The carbon fibre reinforced polymer based, pultruded plate system – **Sika**® **CarboDur**®
- The post-tensioning system for structural strengthening – **Sika**® **CarboStress**®

Sika Solutions for Shear Strengthening

Strengthening systems for the shear strengthening of beams and columns, consisting of **Sikadur**® structural epoxy adhesives and:
- Prefabricated L-shape plates – **Sika**® **CarboShear**® **L** for application on beams
- Uni- or bi-directional **SikaWrap**® fabric strengthening systems based on carbon fibre, For application on beams and columns

Added Value from Sika in Strengthening

Sika CarboDur Heating Device

Accelerated adhesive curing in low temperatures or to reduce closure times, using the innovative electrical heating equipment – **Sika**® **CarboHeater**

Advantages:
- Fast curing of the structural adhesive to reduce closures or time on site
- Allows application of **Sika**® **CarboDur**® strengthening systems at lower temperatures (e.g. in winter)
- Allows application of the Sika strengthening systems under live dynamic load
- Allows the Sika Strengthening systems to be used in increased service temperatures (in conjunction with **Sikadur**®**-30 LP**)

Sika Solutions for Axial Strengthening

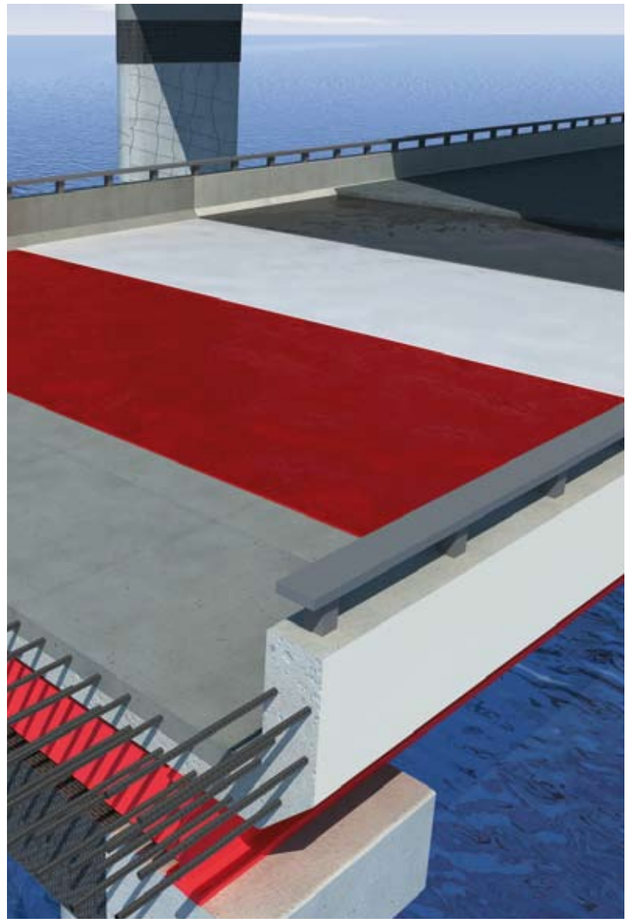
Strengthening systems for the axial strengthening of columns, consisting of **Sikadur**® epoxy adhesives and:
- Uni- or bi-directional **SikaWrap**® fabrics, based on glas or carbon fibres

Sika Solutions for Waterproofing

Overview
To increase the durability of reinforced concrete bridges, all concrete movement and construction joints, plus the bridge decks particularly, have to be waterproofed to prevent serious damage to the concrete, or to the embedded steel reinforcement.
Due to dynamic loading, the bridge decks must be protected with elastic, crack-bridging systems, to accommodate any movement and maintain the protection.

Requirements
- Elastic, crack-bridging properties, especially at low temperatures
- Resistance to chlorides and automotive chemicals such as fuel, oils and hydraulic fluids.
- Easy to install and accommodate variations in level and substrate conditions
- Fast application to reduce traffic closure times.

Sika in Waterproofing
Sika provides a full range of waterproof sealing products and systems for reinforced concrete bridges. These include watertight solutions for all types of joints, crack injection systems and bridge deck waterproofing solutions to solve each specific type of problem.
Sika supports the contracting customers and their clients with unique service and support in these areas including inspection, specification writing, detailing, full on-site support etc.



Added Value in Bridge Deck Waterproofing

Adhesion Promoter for Asphalt Toppings

Sika adhesion promoting systems for asphalt toppings on the waterproofed bridge decks using either **Sikalastic®-827** adhesion promoter pellets or **Sikalastic®-823** adhesive primer.

Advantages:
- High shear transfer loading
- Easy to apply
- Full bond system

Sika Solutions for Bridge Deck Waterproofing

Durable waterproofing systems for concrete and steel bridge decks:
- For concrete bridge decks under hot poured asphalt:
  System consisting of **Sika® Ergodur®** epoxy overlay and **Sikalastic®** liquid applied membrane
- For steel bridge decks under hot poured asphalt:
  System consisting of **SikaCor® HM** Primer and **SikaCor® HM** waterproofing layer
- For steel bridge decks without asphalt topping:
  System consisting of **SikaCor® HM** Primer and **Sika® Elastomastic® TF** waterproof wearing layer

Sika Solutions for Elastic Joint Sealing

High Performance watertight joint sealing systems for use on bridge decks, parapets and other elements:
- For facade and parapet joint waterproofing:
  Sikadur® Combiflex® SG system
- For bridge deck and deck waterproofing edge terminations:
  Sika® Dilatec® B, R and **E** edge systems
- For facade joint waterproofing:
  Sikaflex® joint sealants

Sika Solutions for Waterproofing Cracks

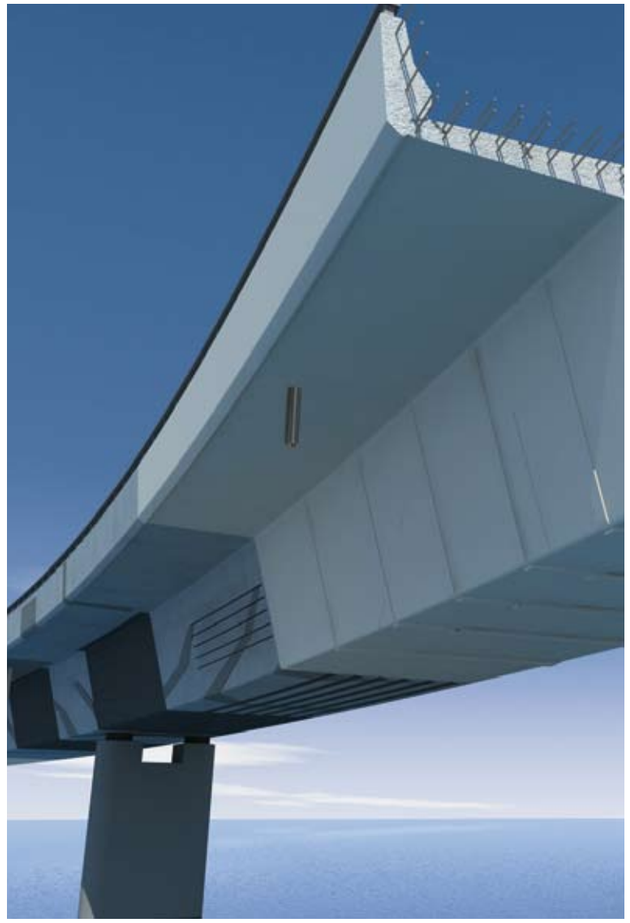
Structural bonding and flexible watertight injection systems for crack sealing in concrete structures:
- For the surface sealing of bridge decks:
  Flexible polyurethane and acrylic resin based injection systems – **Sika® Injection®** systems
- For structural cracks and void repair:
  Sikadur® and **Sika® Injection®** low viscosity, epoxy resin based systems

Sika Solutions for Concrete Protection

Overview
To improve the performance and durability of reinforced concrete surfaces on bridge structures, additional protection systems are frequently required, particularly in refurbishment situations. Typical concrete protection systems for bridges can be classified as hydrophobic impregnations, sealing impregnations, surface coatings, or corrosion inhibitors. These are designed for use in different situations or collectively in alternative combinations, to greatly reduce damage to the concrete surfaces and to stop or significantly reduce the rate of steel reinforcement corrosion. Thus preventing the even more significant structural damage, that would otherwise occur.

Requirements
- Protection against ingress of water, chloride and carbon dioxide
- High resistance against UV radiation
- Resistance against frost and wide temperature variations

Sika in Concrete Protection
Sika provides a wide range of tested and well proven concrete protection systems based on different technologies including hydrophobic impregnations, impregnations, rigid and elastic surface coatings, plus surface applied corrosion inhibitors. All of these Sika products and systems fully comply with various standards and regulations.



Added Value from Sika in Concrete Protection

Durable and Invisible Protection for Fair-Faced Concrete

The unique and complete concrete protection system, consisting of **Sika® FerroGard®-903+** corrosion inhibitor and **Sikagard®-700** series hydrophobic impregnations

Advantages:
- No change in the structure's appearance
- Dual protection behaviour – for steel reinforcement and concrete surfaces
- Cost effective solutions
- Fast and easy to apply

Sika Solutions for Corrosion Mitigation

- Liquid, surface applied corrosion inhibitor:
  Sika® FerroGard®-903+
- Galvanic protection systems:
  Sika® Galvanic anodes*

*note: refer to local country for availability

Sika Solutions for Fair Faced Concrete

Durable, deep penetrating, protective hydrophobic impregnations for facades, beams, columns and all areas of the bridge superstructure:
- Silane based products:
  Sikagard®-706 Thixo /-705 L /-740 W
- Silane/Siloxane combination based products
  Sikagard®-704 S

Sika Solutions for Coloured Concrete

Rigid, continuous film-forming, protective concrete surface coatings:
- High performance, acrylic resin based coating
  Sikagard®-680 S
- Water dispersed, protective acrylic resin based coating:
  Sikagard®-675 W ElastoColor®

Sika Solutions for Cracking Concrete

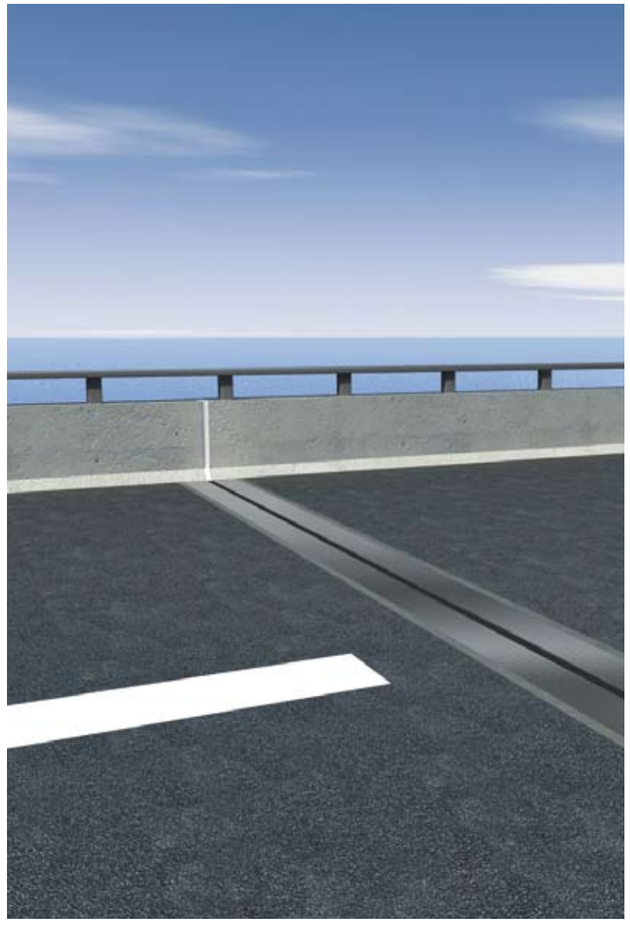
High build, film-forming protective concrete coating system with crack-bridging abilities:
- Water dispersed, high build, acrylic resin based, elastic intermediate and surface levelling coating:
  Sikagard®-545 W Elastofill®
- Water based, high build, elastic crack-bridging, coloured, protective top-coating:
  Sikagard®-550 W Elastic

Sika Solutions for Grouting and Fixing Works

Overview
Remedial works on concrete bridge structures often include the requirement for void filling, fixing and sealing or bedding and grouting with free flowing materials. Typical examples are concrete repairs using formwork, high precision grouting under bridge bearing plates, or for cable duct grouting.
Additionally flowable resin and cement grouts are used to fix manholes or other steel frames and equipment, where rapid hardening materials are usually required to reduce closure times.

Requirements
- High strengths and low creep under permanent load
- Low shrinkage and reduced tendency to cracking
- Excellent flow characteristics
- Easy handling and application
- Fast application and hardening

Sika in Grouting and Fixing
Sika provides a wide range of tested and well proven grouts and fixing materials based on all of the different technologies available including cement, epoxy, polyurethane and PMMA.
For many decades, Sika has also provided special products for high precision applications such as bearing plates, rail tracks and duct sealing.

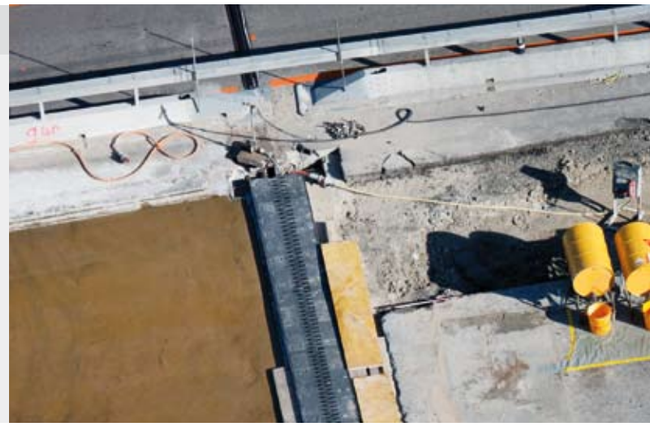


Sika Solutions for Structural Grouting

Materials for grouting under bridge bearing plates and to fill voids, holes and cavities or for embedding drainage pipes and other elements:
- Cement based, high precision grouting products:
  SikaGrout®-300 series
- Epoxy resin based, rapid hardening, high strength grouting products for use under dynamic loading:
  Sikadur®-42 series
- PMMA resin based, grouting products for application at low temperatures down to -10 °C:
  Sikadur®-12 Pronto

Sika Solutions for Fixing of Road Components

Sika® FastFix® systems for road construction and maintenance works:
- Fixing and bedding of manhole frames and mechanical joint hosing:
  Sika® FastFix®-138 TP and **Sika® FastFix®-4**
- Concrete kerb bedding and jointing:
  Sika® FastFix®-1 TP
- Block paviour and stone set pavement bedding and jointing:
  Sika® FastFix®-133 TP



Added Value from Sika in Grouting and Fixing

Filling of Voids within Cable Ducts

SikaGrout®-300 PT, is a highly fluid, cement based slurry grout, including corrosion inhibitors, that is used to fill and seal voids within the cable ducts of post-tensioned structures and to protect steel tendons from corrosion.

Advantages:
- Excellent pumpability
- Extended open time
- Easy to mix and to apply
- Extensive practical experience all over the world

Sika Solutions for Rail Tracks

Rail fixing, damping and bedding solutions for all types of rail track systems to be installed on bridge decks:
- Discrete fixing solutions
  Icosit® KC range
- Direct rail track fixing and bedding solutions:
  Icosit® KC range

Sika Solutions for Steel Corrosion Protection

Overview
Structural steel is also widely used around the world for the construction of bridges and bridge components including the superstructure, parapet railings, decks and cables. The corrosion protection of this steel is therefore essential to increase the durability and sustainability of the structure. Chlorides and condensed water can accelerate the steel corrosion process and must be kept away from the steel surfaces.

Requirements
- Corrosion protection in accordance with EN ISO 12944
- UV and weathering resistance
- Coating system service life of 20 – 25 years to reduce maintenance / closures
- Fulfil high aesthetic demands in appearance
- Low VOC emissions
- Fast curing / short inter-coat waiting times
- Elastic behaviour (systems for steel cable protection particularly)

Sika in Steel Corrosion Protection
Sika provides a wide range of tested and approved steel protection systems based on the latest technologies and our long-term experience with steel coatings. Sika produces the most advance protective coating systems for bridges, designed to be selected in accordance with international standard EN ISO 12944, which ensures the defined service life to the first maintenance and the sustainability is assured.

Sika Solutions for Shop Application

Steel corrosion protection systems with fast curing 2-component epoxy and polyurethane resin based coatings. Designed for shop application with the 3 layer application system build-up possible in a single day:
- High-performance and long-term steel corrosion protection with the **SikaCor® EG -Rapid** System
- Tested and approved in accordance with TL/TP-KOR page 97 and EN ISO 12944 part 5

Sika Solutions for Maintaining Existing Coatings

Protective coating systems for steel maintenance, designed for application on site. Specifically formulated for use on non-blast cleaned surfaces, suitable for use on steel surfaces that are site prepared mechanically with power tools:
- **Sika® Poxicolor® Primer HE** NEU followed by **SikaCor® EG 120**
- Tested and approved in accordance with EN ISO 12944 part 5

Added Value from Sika in Steel Protection

Elastic, Trafficable Deck Waterproofing & Steel Protection

Mechanically resistant and durable, tough elastic coating system for steel decks, based on an epoxy/ polyurethane resin combination, consisting of **SikaCor® HM** Primer and **Sika® Elastomastic® TF**

Advantages:
- Approved for footpaths, cycle tracks and roadway surfacing according to German Standard ZTV-ING T7 A5
- Also approved for bridge ballast trough linings (steel and concrete), according to German Standard TL/TP-KOR page 84
- Directly trafficable surface
- Sets the ‘State of the Art’ in system cost efficiency and durability
- Available in different colour shades

Sika Solution for Protecting Steel Bridge Cables

A unique protective coating system, especially designed for the protection of structural steel cables on cable-stayed bridge structures. The system includes flexible coatings and injection products for corrosion protection in steel cable anchors and connectors:
- **Sika® Cable System**
- Tested and approved in accordance with German Standard TL/TP-KOR “Seile”

Sika Solutions for Structural Bonding Works

Overview
Structural adhesives are used for many bonding applications in new construction and refurbishment. The bond must allow the transfer of high loads without deformation and creep.
The main function of structural adhesives is in the bonding of similar or dissimilar materials together (i.e. concrete to steel, steel to composites etc). Dependent on their design, structural adhesives can not only bond the elements together, but they can also fulfil additional functions such as waterproofing, sealing, concrete protection or even vibration dampening.

Requirements
- Good creep resistance
- Uniform and direct load transmission
- Resistant and able to accommodate dynamic loading
- Good ageing resistance

Sika in Structural Bonding
Sika has been a pioneer in the use of resin adhesives for structural bonding of precast concrete elements since the 1960's. Sika's epoxy adhesives have now been used to bond segmental bridge structures all around the world. This extensive experience has allowed the development of a wide range of additional structural bonding products and systems for unique applications. In the 1990's Sika also introduced a complete range of cartridge applied resin anchoring adhesives for many different applications.

Added Value from Sika in Structural Bonding

Structural Bonding of Ultra High Performance Concrete (UHPC)

Sikadur®-30 epoxy adhesive for the structural bonding of Ultra High Performance Concrete (UHPC) precast elements

Advantages:
- High mechanical strengths
- Good creep behaviour
- No shrinkage
- High durability, even at high temperatures and high humidity
- Resistant to freeze/thaw exposure
- High fatigue resistance under dynamic load
- High abrasion, shock and impact resistance
- Good chemical resistance (including to oils and de-icing salts etc.)

Sika Solutions for Rigid Structural Bonding

Epoxy adhesives for bonding different elements or components to concrete, steel or bituminous substrate:
- **Sikadur®-30** for high-performance bonding of steel plates on to concrete
- **Sikadur®-31 CF** for multi-purpose bonding such as precast concrete or natural stone kerbs onto concrete or asphalt surfaces

Sika Solutions for Structural Anchoring

Special structural adhesives for anchoring all types of fittings and equipment to bridge structures such as for the installation of cable trays or other services, crash barriers, drainage pipes, inspection access equipment, catch nets, etc.:
- ETAG approved, structural resin anchoring adhesive **Sika® AnchorFix®-2**, for the installation of threaded rods and steel dowel bars at temperatures as low as -5 °C.
- High performance, epoxy resin based, anchoring adhesive **Sika® AnchorFix®-3+**, for secure structural installations, even into damp substrates

Sika Solutions for Steel Fixtures and Fittings

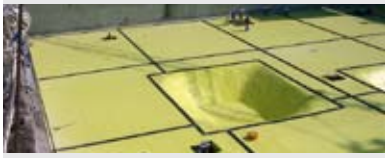
Special epoxy mortars for the bedding, bonding and dry-packing of many different types of fixtures and fittings, including steel frames and parapet railings, etc.:
- 3-component, non-shrink, epoxy resin based mortars **Sikadur®-41 CF** and **Sikadur®-43 HE**

Sika Full Range Solutions for Construction

Concrete Production

Sika® ViscoCrete®
Sika® Retarder®
Sika® SikaAer®

Waterproofing



Sikaplan®, Sikalastic®
Sika® & Tricosal® Waterstops
Sika® Injection Systems

Flooring

Sikafloor®
SikaBond®

Corrosion and Fire Protection

SikaCor®
Sika® Unitherm®

Concrete Repair and Protection

Sika® MonoTop®
Sikagard®
Sikadur®

Structural Strengthening

Sika® CarboDur®
SikaWrap®
Sikadur®

Joint Sealing

Sikaflex®
Sikasil®

Grouting

Sikadur®
SikaGrout®

Roofing

Sarnafil®
Sikaplan®
SikaRoof® MTC®

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